CALIPSO

Science Overview

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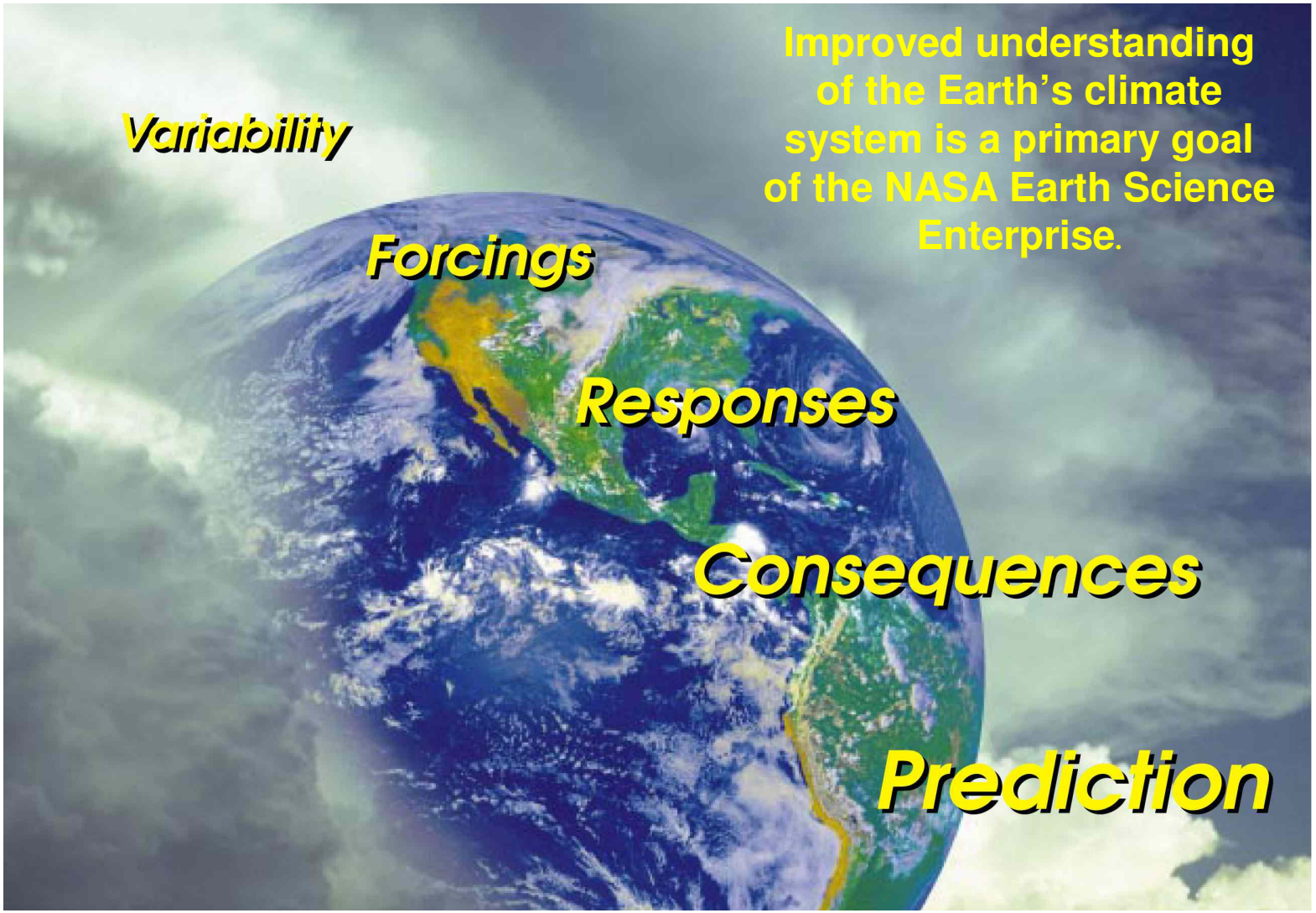
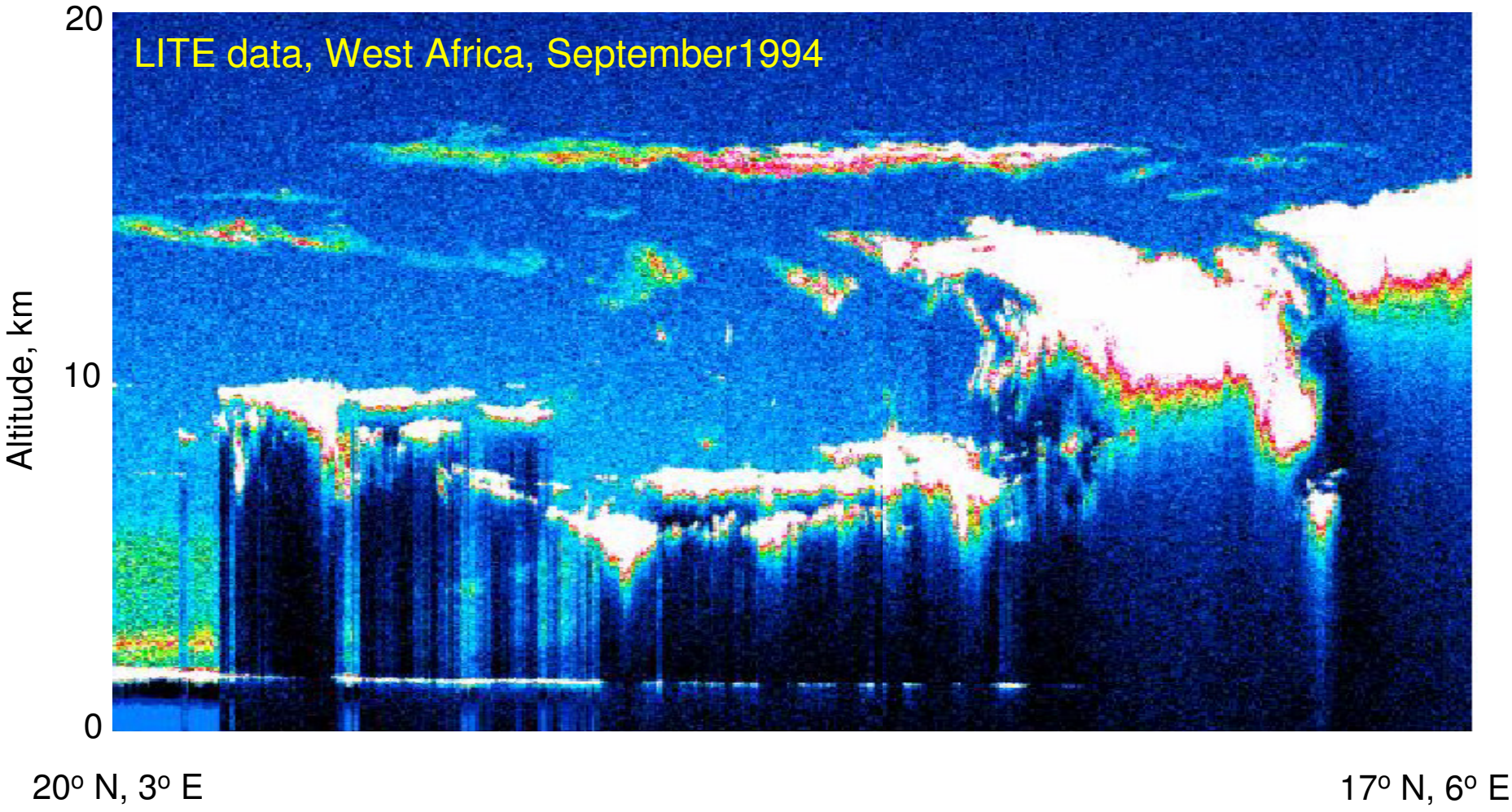
CALIPSO Science Team Member

ESE Research Themes

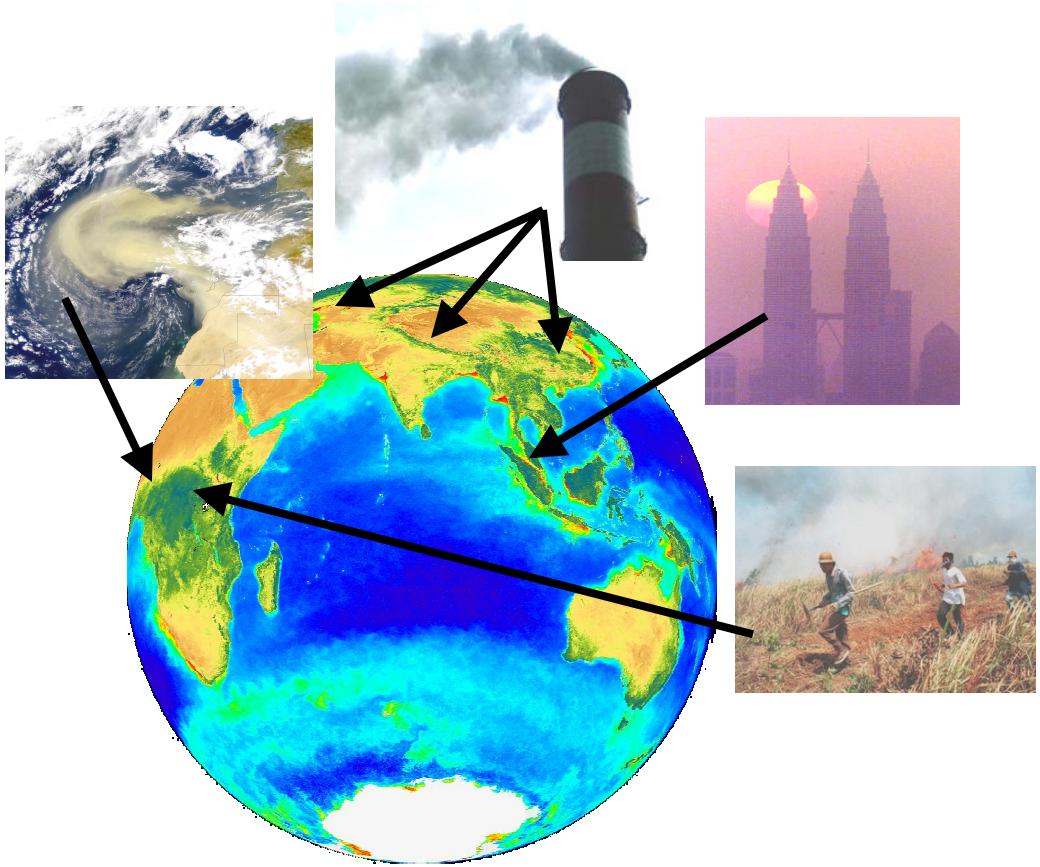


One Big Uncertainty: The Effects of Multilayer Clouds



What are Aerosols??

Aerosols are small particles and can remain suspended in the atmosphere for days or weeks.



Natural Sources
- **desert dust**
- **forest fires**
- **sea spray**
- **volcanic eruptions**

Human-related Sources
- **fossil fuel burning**
- **biomass burning**
- **dust resulting from land clearing**

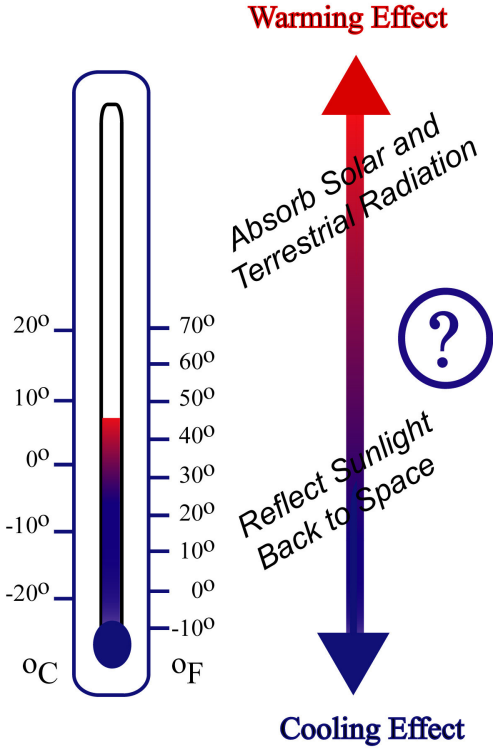
How do aerosols affect the climate?

Aerosols Directly Influence the Earth's Energy Balance

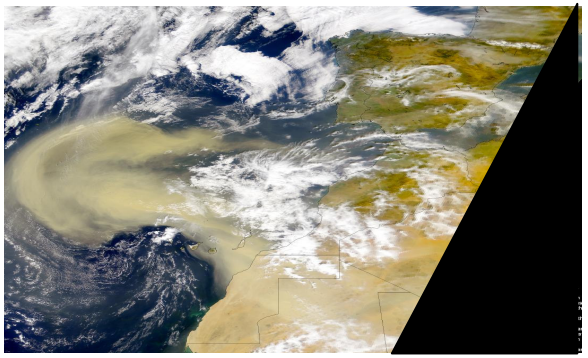
Human-Related Sources

Sulfates, Soot

Biomass Burning



Natural Sources



Desert Dust

Sea Salt

Aerosols may have a warming or cooling effect depending on their optical properties and surface brightness – key parameters measured by CALIPSO.

How do aerosols affect the climate?

Atmospheric aerosols directly affect the Earth's energy balance by:

- absorbing and scattering solar radiation
- absorbing and emitting infrared radiation

Atmospheric aerosols indirectly affect the Earth's energy balance by:

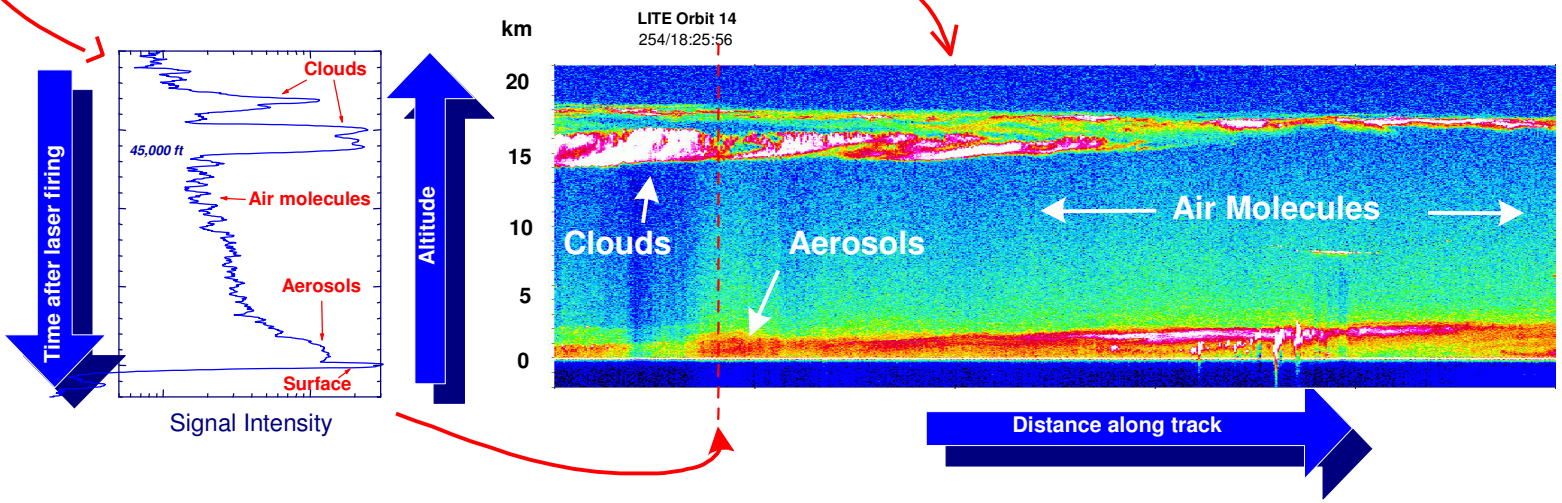
- acting as cloud condensation nuclei and modify the reflectance and lifetime of clouds

Lidar Observations from Space

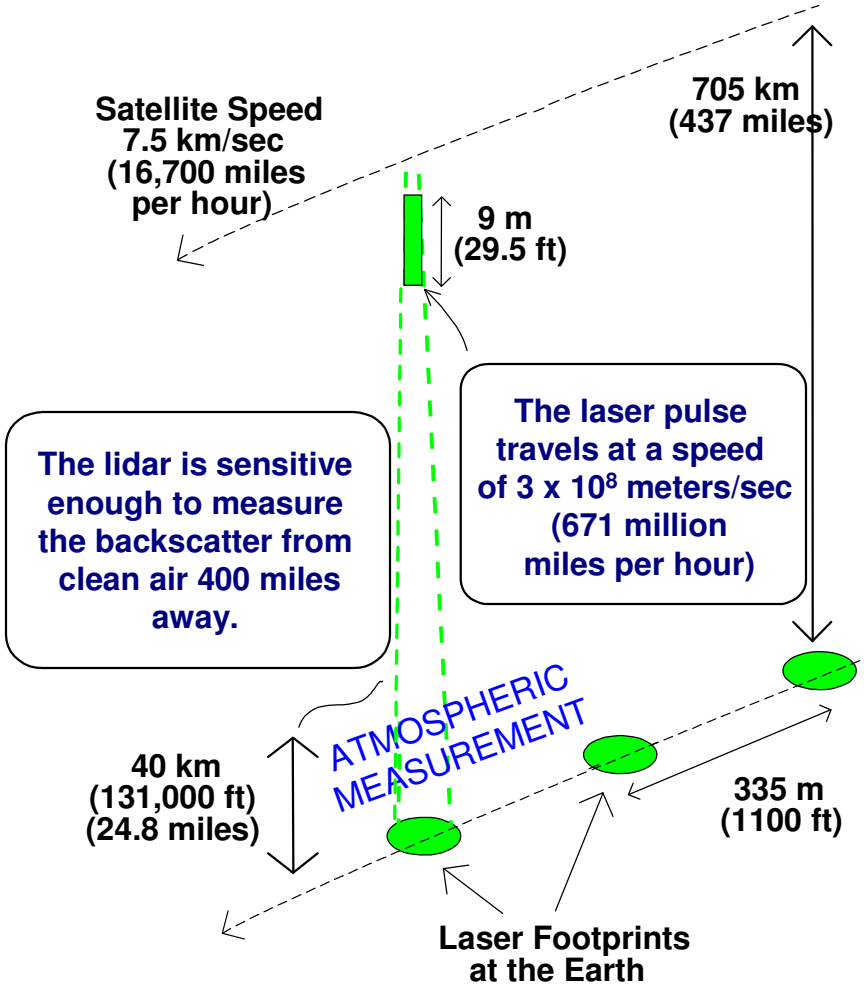
A lidar is an optical remote sensing instrument that makes range-resolved measurements of backscattered laser light to provide vertical profiles of atmospheric constituents.

HOW DOES A SPACEBORNE LIDAR WORK?

1. A very short and intense pulse of laser light is sent downward toward the Earth.
2. The light backscatters from particles in the atmosphere.
3. The backscattered light is collected by a telescope and converted to an electrical signal .
4. The signal strength is measured thousands of times while the laser pulses passes down through the atmosphere. Each measurement corresponds to a specific altitude above sea level.
5. A combination of all the measurements for a single shot give a vertical profile of the atmospheric backscatter intensity.
6. Multiple shots, color coded by backscatter intensity, give a two-dimensional view of the atmosphere.



Lidar Observations from Space



THE LASER

Diode-pumped frequency-doubled Nd:YAG.

Two simultaneous wavelengths:

532 nm (green) and 1064 nm (infrared).

Fires 20 pulses per second.

Each pulse has a duration of 30 billionths of a second (30 nanoseconds).

Peak power at each wavelength is over 3 million watts.

Average power at each wavelength is 2 watts.

After each laser shot the lidar measures the signal at 2,670 different altitudes in 267 microseconds.

An F-15 flying at twice the speed of sound would travel 9 inches during that time!

CALIPSO is a partnership

Langley Research Center: mission lead, program management, system engineering, payload mission operations, validation, and data processing and archival

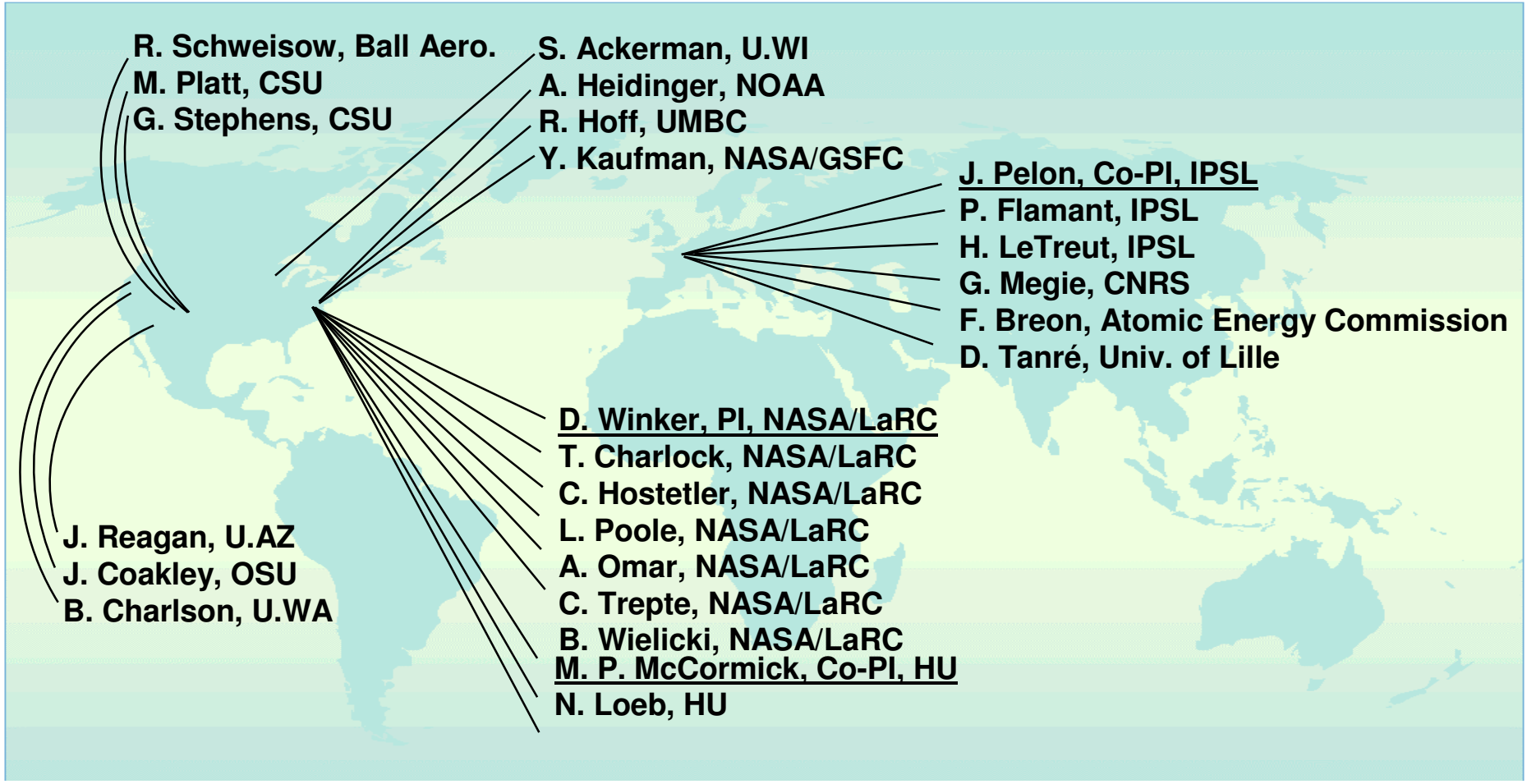
Centre National d'Etudes Spatiales: provide Alcatel PROTEUS spacecraft and IIR instrument, payload-to-spacecraft integration, and spacecraft mission operations

Hampton University: lead algorithm implementation and manage educational and public outreach

Ball Aerospace & Technologies Corp.: develop the lidar and WFC and provide instrument-to-payload integration, launch vehicle support, and science data downlink

Institut Pierre Simon Laplace: lead French science studies, validation, IIR algorithm development and provide data archival

Science Team



Science Objectives

Primary

- Observationally-based estimates of direct and indirect aerosol radiative forcing
- Improved characterization of surface longwave radiative fluxes and atmospheric heating rates
- Improved model parameterizations of cloud-climate feedbacks

Secondary

- Complementary measurements to validate and improve EOS Aqua data retrievals
- Data to improve the representation of aerosols in chemical models
- Monitoring long-range transport of pollutants
- Polar stratospheric cloud climatology for chemistry applications